Estimate of Number of Deuterons Delivered to and lost in the TTB Line

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September 30, 2007

1 Number of Deuterons Delivered to the End of the TTB Line in a Given Time

Assume

$$n = 1.5 \times 10^{11} \tag{1}$$

deuterons per Tandem pulse at the end of the TTB line.

Assume AGS repetition period

$$P = 3.6 \tag{2}$$

seconds.

Let m be the number of Tandem pulses per AGS cycle.

Then the number of deuterons delivered to the end of the TTB line in T seconds is

$$N = mnT/P \tag{3}$$

and the number delivered in H hours is

$$N = mnkH/P \tag{4}$$

where

$$k = 3600. \tag{5}$$

Thus, for $m = 1$ we get 1.5×10^{14} deuterons per hour at the end of the TTB line; for $m = 8$ we get 1.2×10^{15} deuterons per hour.

2 Number of Deuterons Lost in the TTB Line in a Given Time

Let E be the transport efficiency of the TTB line.

Then the number of deuterons lost in the TTB line in T seconds is

$$L = \left(\frac{1-E}{E}\right) mnT/P \tag{6}$$

and the number lost in H hours is

$$L = \left(\frac{1-E}{E}\right) mnkH/P. \tag{7}$$

We shall assume that

$$E = 0.85. \tag{8}$$

3 Tandem, Booster and AGS Setup Period

4 days with $m = 1$ and $H = 10$ gives $N = 6 \times 10^{15}$, $L = 1.06 \times 10^{15}$.

2 days with $m = 8$ and $H = 10$ gives $N = 24 \times 10^{15}$, $L = 4.24 \times 10^{15}$.

7 days with $m = 8$ and $H = 12$ gives $N = 101 \times 10^{15}$, $L = 17.8 \times 10^{15}$.

This gives a total of

$$N = 131 \times 10^{15} \tag{9}$$

deuterons delivered to the end of the TTB line, and a total of

$$L = 23 \times 10^{15} \tag{10}$$

deuterons lost in the TTB line during this period.

4 Collider Setup Period

4 days with $m = 8$ and $H = 12$ gives $N = 57.6 \times 10^{15}$, $L = 10.2 \times 10^{15}$.

7 days with $m = 8$ and $H = 12$ gives $N = 101 \times 10^{15}$, $L = 17.8 \times 10^{15}$.

This gives a total of

$$N = 159 \times 10^{15} \tag{11}$$

deuterons delivered to the end of the TTB line, and a total of

$$L = 28 \times 10^{15} \tag{12}$$

deuterons lost in the TTB line during this period.

5 Collider Intensity Ramp-Up Period

7 days with $m = 8$ and $H = 12$. This gives a total of

$$N = 101 \times 10^{15} \tag{13}$$

deuterons delivered to the end of the TTB line, and a total of

$$L = 18 \times 10^{15} \tag{14}$$

deuterons lost in the TTB line during this period.

6 Physics Data Taking Period

We assume that the collider has stored beams for 85 hours each week. We take the average length of a store to be 5 hours. This gives 17 stores per week. We assume that during each store, 1 hour is used to tune the injectors with deuteron beam. We assune further that 16 of the 83 non-store hours are used for tuning the injectors and the collider with deuteron beam. This gives a total of $H = 17 + 16 = 33$ hours of tuning with deuteron beam each week during the Physics data taking period. Taking $m = 8$ we then get a total of

$$N = 40 \times 10^{15} \tag{15}$$

deuterons delivered to the end of the TTB line, and a total of

$$L = 7 \times 10^{15} \tag{16}$$

deuterons lost in the TTB line each week.

The Physics data taking period is expected to last 11 weeks.